

BONES OF THE SKULL (1)

8 CRANIAL +

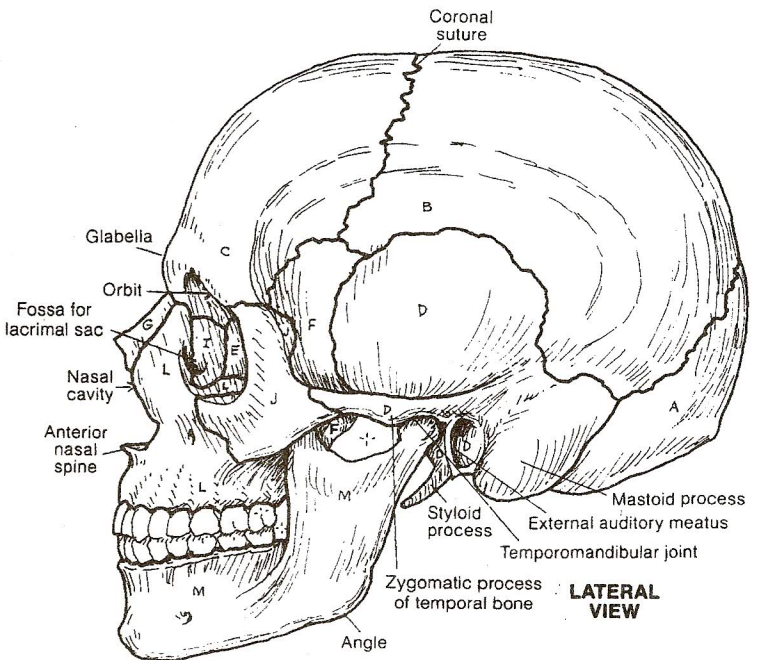
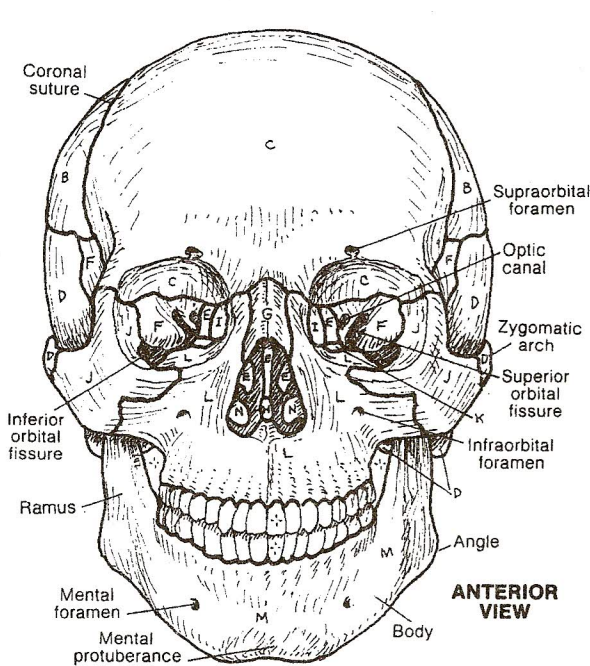
OCCIPITAL_A 2 PARIETAL_B FRONTAL_C
2 TEMPORAL_D ETHMOID_E SPHENOID_F

14 FACIAL +

2 NASAL_G VOMER_H 2 LACRIMAL_I
2 ZYGOMATIC_J 2 PALATINE_K 2 MAXILLA_L
MANDIBLE_M 2 INFERIOR NASAL CONCHA_N

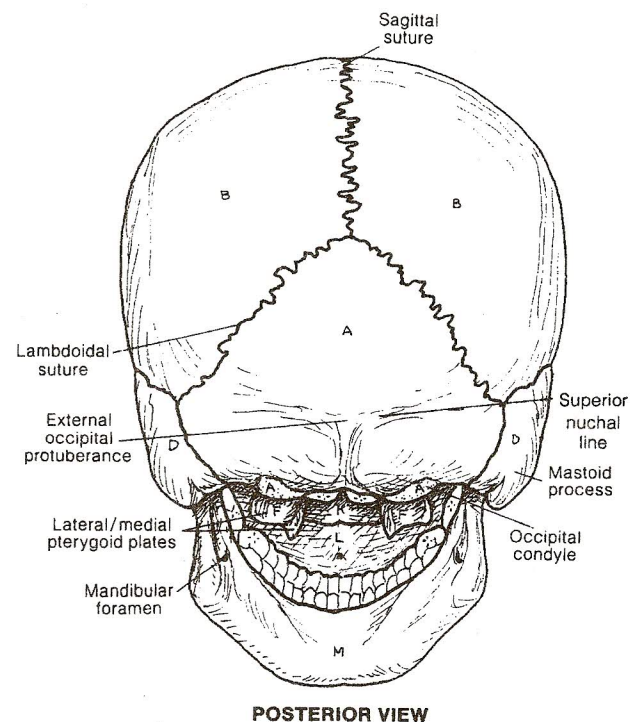
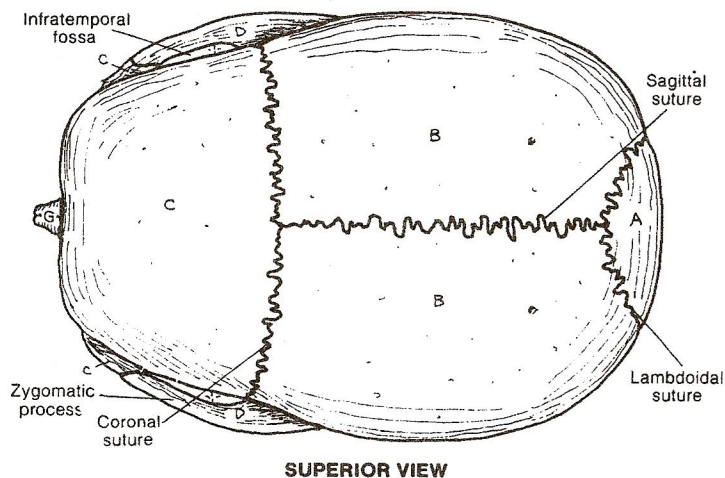
CN: Save the brightest colors for the smallest bones and the lightest colors for the largest. (1) Color one bone in as many views as it appears before going on to the next. (2) There are some very small bones to color in the

orbits and in the lower part of the posterior view of the skull. Study these areas carefully before coloring to determine the color boundaries. (3) Do not color the darkened areas in the orbits and nasal cavity in the anterior view.



The skull is composed of *cranial bones* (forming a vault for the brain) and *facial bones* (giving origin to the muscles of facial expression and providing buttresses protecting the brain). Except for the temporomandibular joint (a synovial joint), all bones are connected by generally immovable fibrous sutures.

The orbit is composed of seven bones, has three significant fissures/canals, and is home to the eye and related muscles, nerves, and vessels. The most delicate of the skull bones is at the medial orbital wall. The external nose is largely cartilaginous and is therefore not part of the bony skull.

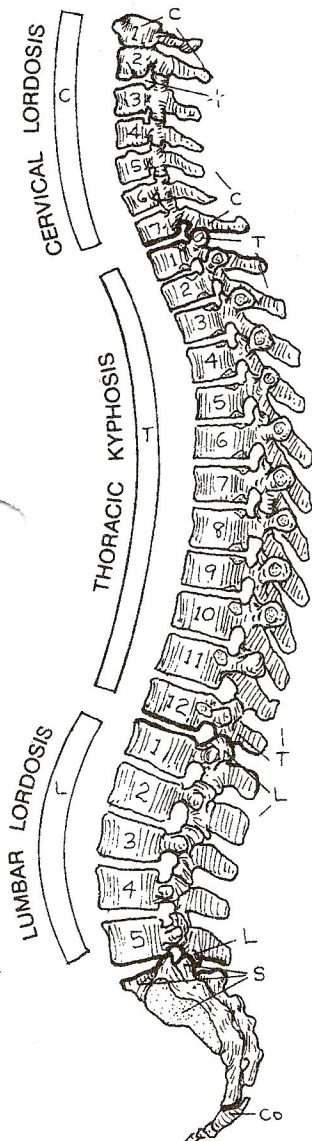


VERTEBRAL COLUMN

CN: Use gray for D, yellow for H, and light colors for the rest, especially C, T, L, S, and Co. L4 and L5 represent the lumbar vertebrae most involved in motion. (1) Begin with regions of the column and the three examples of vertebral disorders at lower left. (2) Color the motion segment and its role in flexion and extension. (3) Color the vertebral foramina and canal. (4) Color the example of a protruding intervertebral disc pressing on a spinal nerve.

REGIONS

CERVICAL_C
THORACIC_T
LUMBAR_L
SACRAL_S
COCCYGEAL_{Co}



The vertebral column has 24 individual vertebrae arranged in *cervical*, *thoracic*, and *lumbar* regions; the *sacral* and *coccygeal* vertebrae are fused (*sacrum*/*coccyx*). Numbers of vertebrae in each region are remarkably constant; rarely S1 may be free or L5 may be fused to the sacrum (*transitional vertebrae*). The seven mobile cervical vertebrae support the neck and the 3-4 kg (6-8 lb) head. The cervical spine is normally curved (*cervical lordosis*) secondary to the development of postural reflexes about three months after birth. The 12 thoracic vertebrae support the thorax, head, and neck. They articulate with 12 ribs bilaterally. The thoracic spine is congenitally curved (*kyphosis*) as shown. The five lumbar vertebrae support the upper body,

torso, and low back. The column of these vertebrae becomes curved (*lumbar lordosis*) at the onset of walking at 1-2 years of age. The sacrum is the key-stone of a weightbearing arch involving the hip bones. The sacral/coccygeal curve is congenital. The variably numbered 1-5 coccygeal vertebrae are usually fused, although the first vertebra may be movable.

Vertebral curvatures may be affected (usually exaggerated) by posture, activity, obesity, pregnancy, trauma, and/or disease; these conditions are given the same names as the normal curves. A slight lateral curvature to the spine often reflects dominant handedness; a significant, possibly disabling, lateral curve (*scoliosis*) may occur for many reasons.

MOTION SEGMENT

VERTEBRA_†

JOINTS:

INTERVERTEBRAL DISC_A

POSTERIOR (FACET)_B

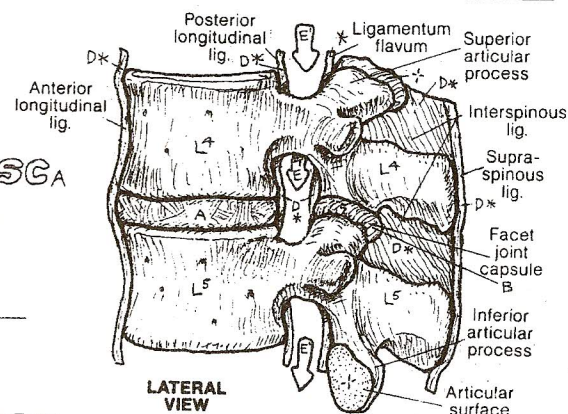
LIGAMENT_{D*}

VERTEBRA_{L⁵}

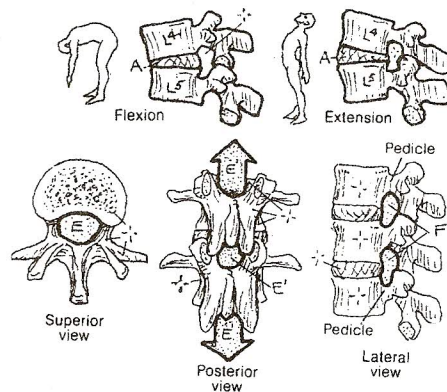
VERTEBRAL FORAMEN_E

VERTEBRAL CANAL_{E'}

INTERVERTEBRAL FORAMEN_F



Each pair of individual, unfused vertebrae constitutes a *motion segment*, the basic movable unit of the back. Combined movements of motion segments underlie movement of the neck and the middle and low back. Each pair of vertebrae in a motion segment, except C1-C2, is attached by three joints: a partly movable, *intervertebral disc* anteriorly and a pair of gliding synovial *facet* (*zygapophyseal*) joints posteriorly. *Ligaments* secure the bones together and encapsulate the facet joints (*joint capsules*). The *vertebral* or *neural canal*, a series of *vertebral foramina*, transmits the spinal cord and related coverings, vessels, and nerve roots. Located bilaterally between each pair of vertebral pedicles are passageways, each called an *intervertebral foramen*, transmitting spinal nerves, their coverings/vessels, and some vessels to the spinal cord.



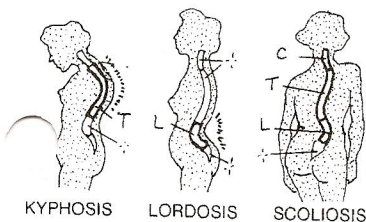
INTERVERTEBRAL DISC_A

ANNULUS FIBROSUS_{A'}

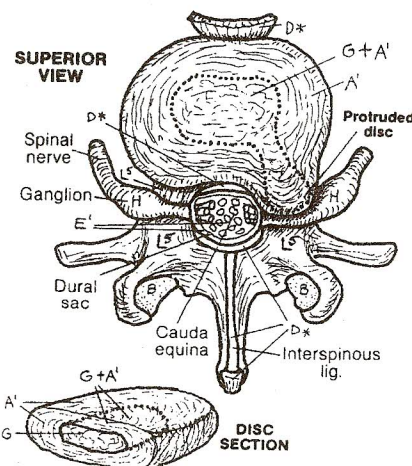
NUCLEUS PULPOSUS_C

SPINAL NERVE_H

VERTEBRAL DISORDERS



The intervertebral disc consists of the *annulus fibrosus* (concentric, interwoven collagenous fibers integrated with cartilage cells) attached to the vertebral bodies above and below, and the more central *nucleus pulposus* (a mass of degenerated collagen, proteoglycans, and water). The discs make possible movement between vertebral bodies. With aging, the discs dehydrate and thin, resulting in a loss of height. The cervical and lumbar discs, particularly, are subject to early degeneration from one or more of a number of causes. Weakening and/or tearing of the annulus can result in a broad-based bulge or a localized (focal) protrusion of the nucleus and adjacent annulus; such an event can compress a *spinal nerve root* as shown.



BONY THORAX

CN: Use the same colors as were used on Plate 22 for true ribs, thoracic vertebrae, demifacets, and transverse process facets. Use bright colors for A-C. (1) Color the anterior view of the bony thorax. Color each rib completely before going on to the next. (2) Color the posterior

view in the same manner. (3) Color the lateral view of the bony thorax. (4) When coloring the drawings of a rib and the sites of articulation, note that the rib facets (drawn with dotted lines) are to be colored even though they are on the underside of the rib.

STERNUM

MANUBRIUM_A

BODY_B

XIPHOID PROCESS_C

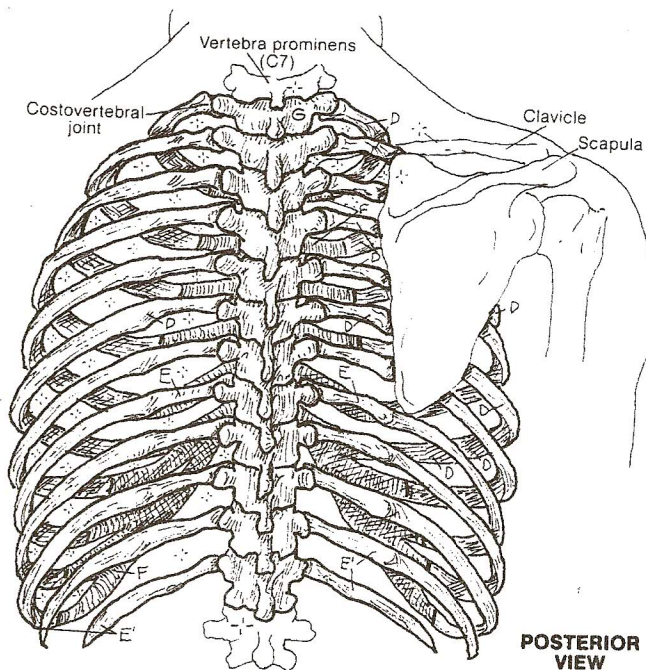
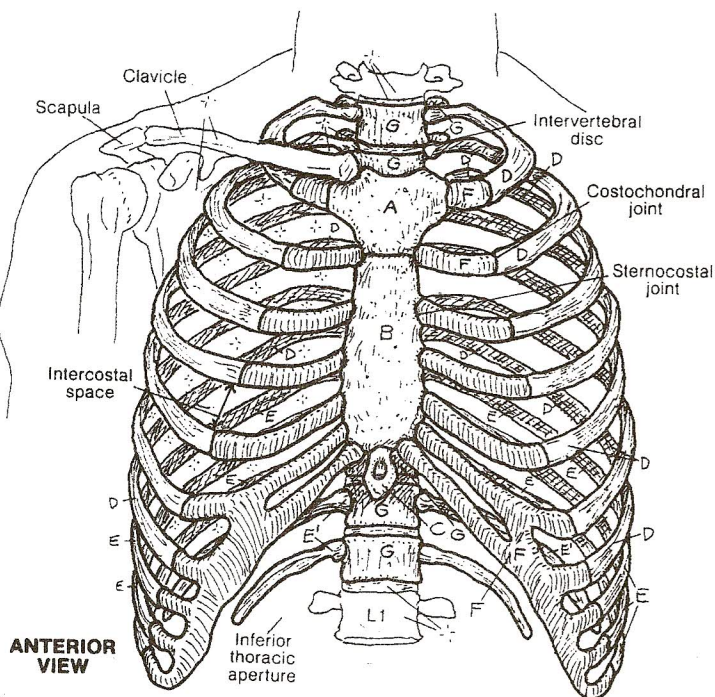
12 RIBS

7 TRUE_D

5 FALSE_E

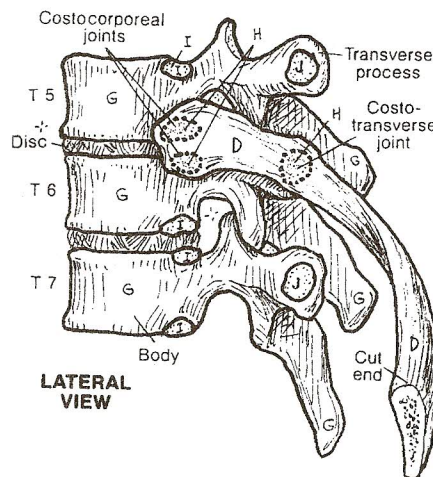
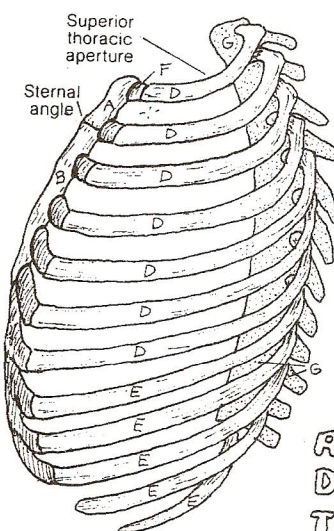
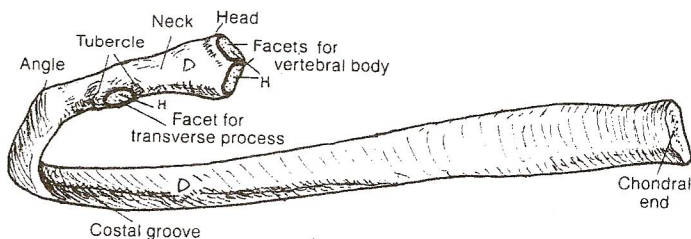
(2 FLOATING)_F

COSTAL
CARTILAGE (10)_F
THORACIC
VERTEBRA (12)_G



The bony thorax is the skeleton of the chest, harboring the heart, lungs, and other significant organs. The superior thoracic aperture or thoracic inlet (often called thoracic outlet by surgeons) transmits the esophagus, trachea, nerves, and important ducts and vessels (Plate 104). The inferior thoracic aperture is virtually sealed by the thoracic diaphragm (muscle), through which pass the aorta, inferior vena cava, and esophagus (Plate 50). The region between each pair of ribs is the intercostal space, containing muscle, fasciae, vessels, and nerves (Plate 50). Collective rib movement is responsible for about 25% of the respiratory effort (inhalation, exhalation); the diaphragm does the rest (Plate 135).

The fibrocartilaginous joint between the *manubrium* and the body of the *sternum* (sternal angle, sternomanubrial joint) makes subtle hinge-like movements during respiration. The xiphoid makes a fibrocartilaginous (xiphisternal) joint with the body of the sternum. The sternum is largely cancellous bone containing red marrow. The *costal cartilages*, representing unossified cartilage models of the anterior ribs, articulate with the sternum by gliding-type synovial joints (sternocostal joints, except for the first joint, which is not synovial). All ribs form synovial joints with the thoracic vertebrae (costovertebral joints). Within each of these joints, the rib (2 through 9) forms a synovial joint with a demifacet of the upper vertebral body and with a *demifacet* of the lower body (costocorporeal joints). In addition, the tubercle of the rib articulates with cartilaginous facet at the tip of the transverse process of the *lower vertebra* (costotransverse joint). Ribs 1, 10, 11, and 12 each join with one vertebra instead of two; ribs 11 and 12 have no costotransverse joints. *True ribs* (1-7) articulate directly with the sternum. Ribs 8-12 are called *false ribs*; ribs 8-10 articulate indirectly with the sternum (via cartilages connecting to the 7th costal cartilage) and ribs 11 and 12 (*floating ribs*) end in the muscular abdominal wall.



RIB FACET_H
DEMIFACET_I
TRANSVERSE FACET_J